

Keywords: Avalanche Photo Diode bias,boost converter

REFERENCE DESIGN 4374 INCLUDES: ✓Tested Circuit ✓Schematic ✓BOM ✓Test Data ✓Layout

Power Supply and Accurate Current Monitor for Avalanche Photodiode (APD) Biasing Applications

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Mar 31, 2009

Abstract: This reference design presents a circuit for addressing the power-supply and current-monitoring requirements of APD biasing applications. Based on the MAX15031 DC-DC converter, the application circuit provides a 70V, 4mA, DC-DC power converter with a 2.7V to 11V input supply-voltage range.

Key specifications for this reference design are listed below, along with a detailed schematic (**Figure 1**) and bill of materials (**Table 1**) for the application.

Design Specifications and Setup

- Wide, 2.7V to 11V input supply-voltage range
- 70V output voltage
- 4mA output current
- Fixed, 400kHz switching frequency
- -40°C to +125°C operating temperature range
- Tiny, 8mm x 12mm circuit footprint

Schematic of the Reference Design

Figure 1 presents the reference design schematic for a 2.7V to 5.5V input range. The same circuit can be used for inputs from 5.5V to 11V by connecting the CP pin to V_{IN} and removing the charge-pump capacitor (C3).

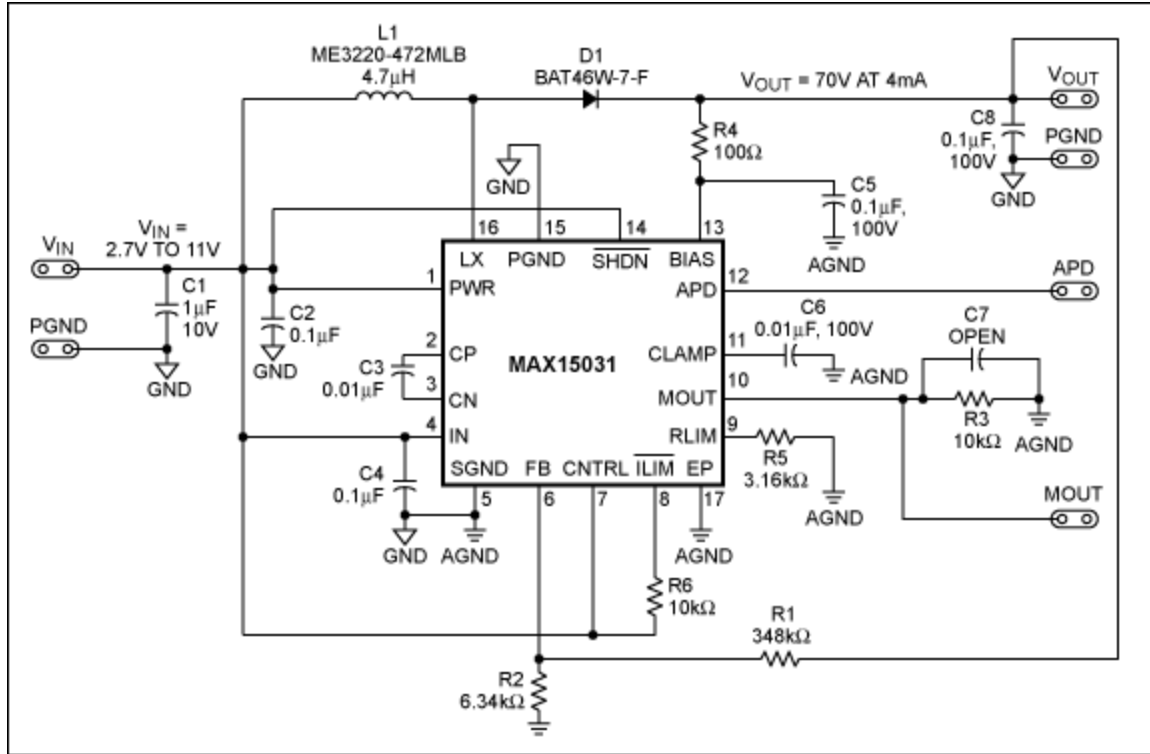


Figure 1. Schematic of the MAX15031 boost converter for $F_{SW} = 400\text{kHz}$ (fixed).

Table 1. Bill of Materials (BOM)

Designator	Value	Description	Part	Footprint	Manufacturer	Quantity
C1	1 μF , 10V	Capacitor	GRM155R61A105KE15	0402	Murata	1
C2, C4	0.1 μF , 16V	Capacitors	GRM155R71C104KA88	0402	Murata	2
C3, C6	0.01 μF , 25V	Capacitors	GRM155R71E103KA01D	0402	Murata	2
C5, C8	0.1 μF , 100V	Capacitors	GCM21BR72A104KA37L	0805	Murata	2
C7	0	Capacitor	Open	0402	Open	1
D1	100V, 150mA	Schottky diode	BAT46W-7-F	SOD-123	Diodes Inc.	1
L1	4.7 μH	Inductor	ME3220-472MLB	3mm x 3mm	Coilcraft	1
R1	348k Ω	Resistor	SMD, 1%, 0.125W	0402	Vishay	1
R2	6.34k Ω	Resistor	SMD, 1%, 0.125W	0402	Vishay	1
R3, R6	10k Ω	Resistors	SMD, 1%, 0.125W	0402	Vishay	2
R4	100 Ω	Resistor	SMD, 1%, 0.125W	0402	Vishay	1
R5	3.16k Ω	Resistor	SMD, 1%, 0.125W	0402	Vishay	1
U1	MAX15031	Boost converter	MAX15031ATE+	16-TQFN-EP	Maxim	1

Waveforms Depicting the Performance of the Design

Figure 2 and Figure 3 show the performance of the Figure 1 circuit. From the LX node voltage, it can be known that the converter is operating in a discontinuous mode of operation. The circuit is designed for a 70V output (V_{OUT}) while the input (V_{IN}) is kept at 3.3V.

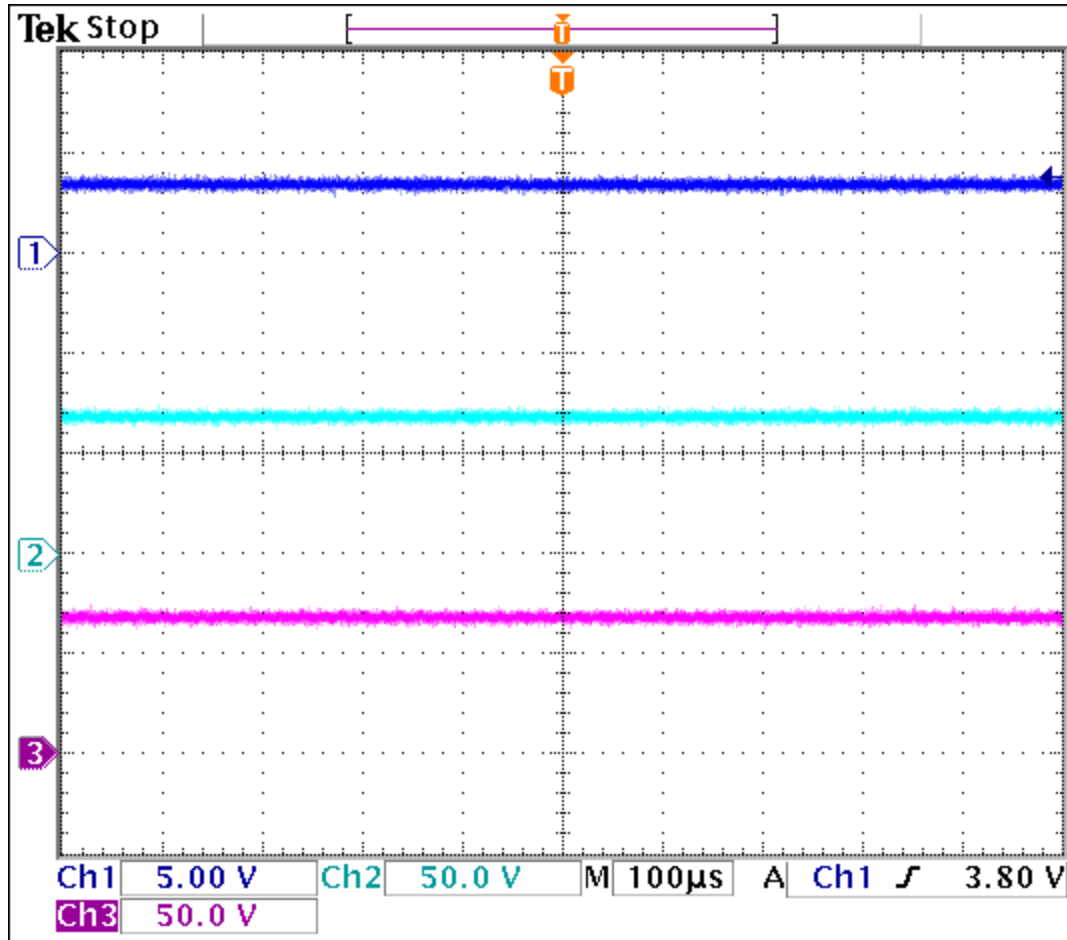


Figure 2. V_{IN} (Channel 1), V_{OUT} (Channel 2), and APD (Channel 3) at 3.3V input.

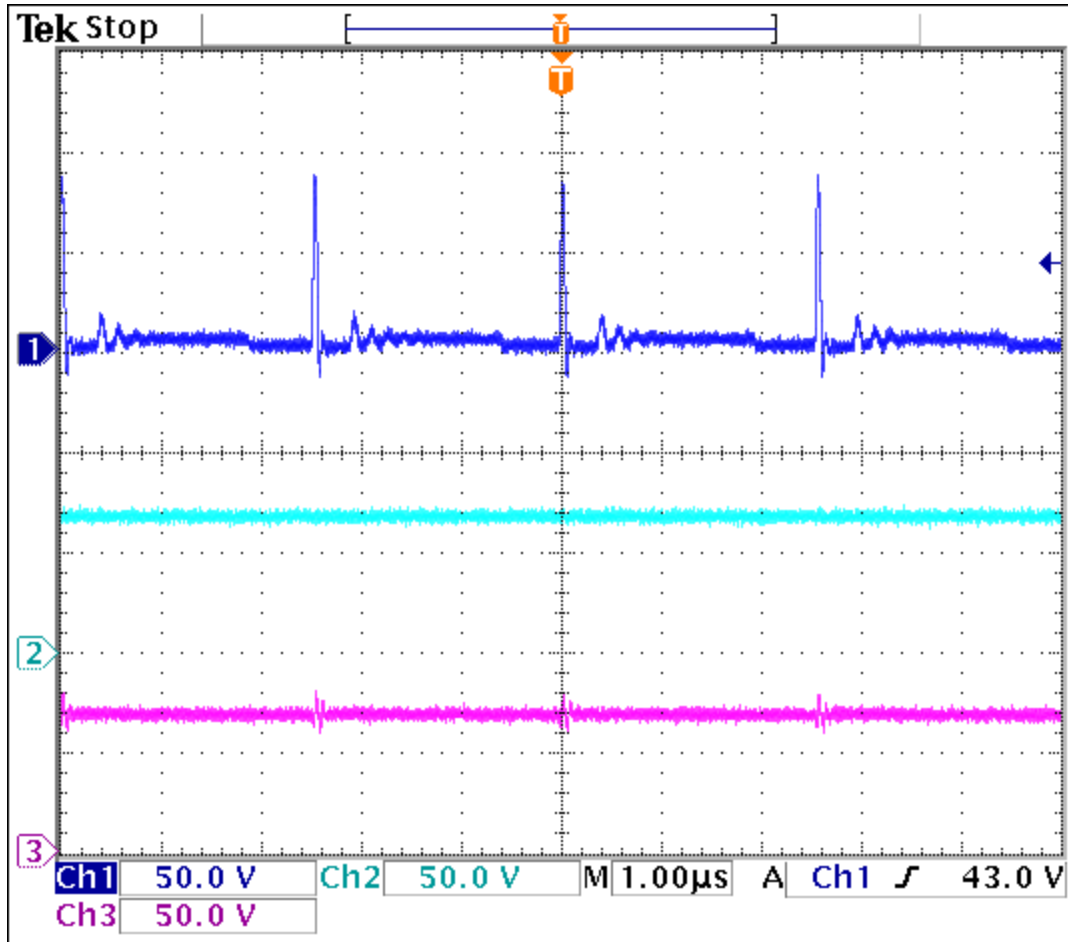


Figure 3. LX node voltage (Channel 1), V_{OUT} (Channel 2), and APD output (Channel 3) at $V_{IN} = 3.3$ V with an APD current of 4mA.

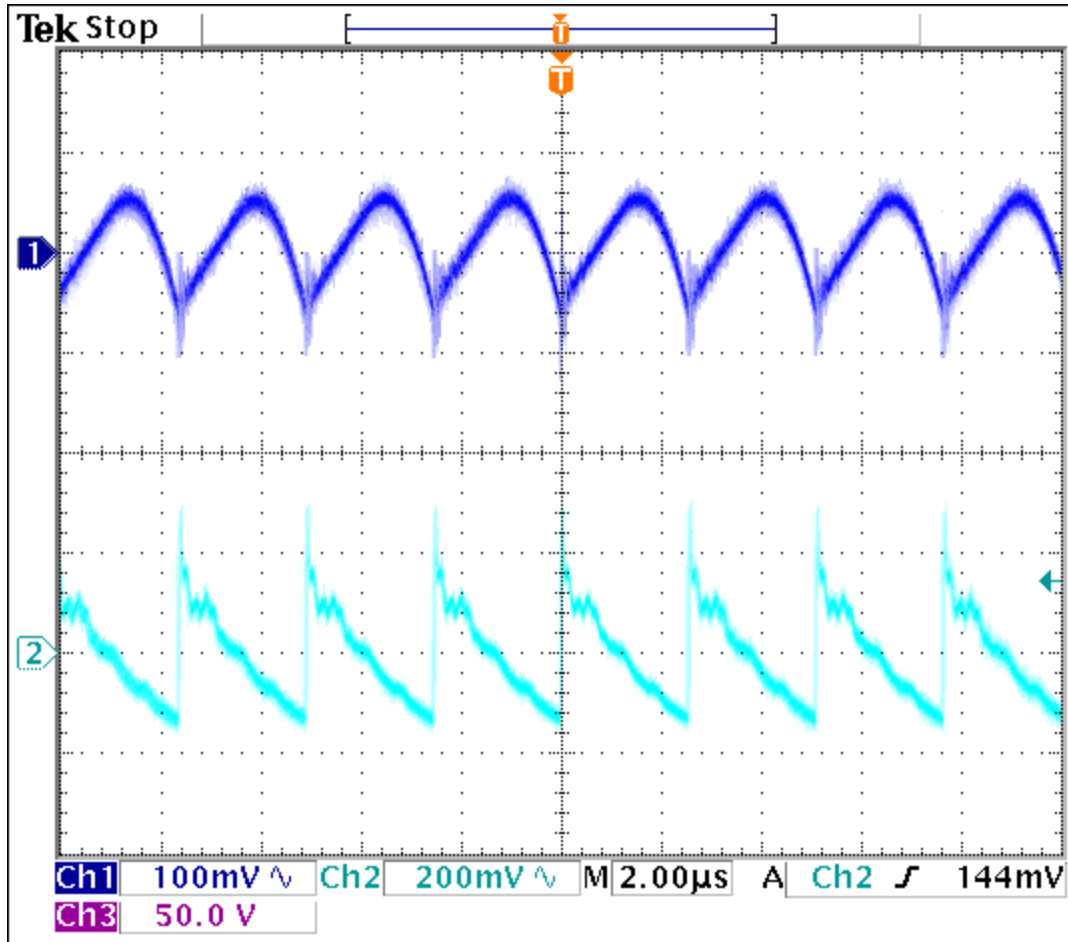


Figure 4. Input ripple (Channel 1) and output ripple (Channel 2) at $V_{IN} = 3.3V$ with an APD current of 4mA.

Figure 4 shows the input (V_{IN}) and output (V_{OUT}) ripple when input voltage is kept at 3.3V and the load current is 4mA.

Figure 5 shows the voltage across RLIM when the current reaches the current limit. In this case, the current limit is set at 4mA. When the current limit is reached, the voltage across RLIM is equal to 1.245V.

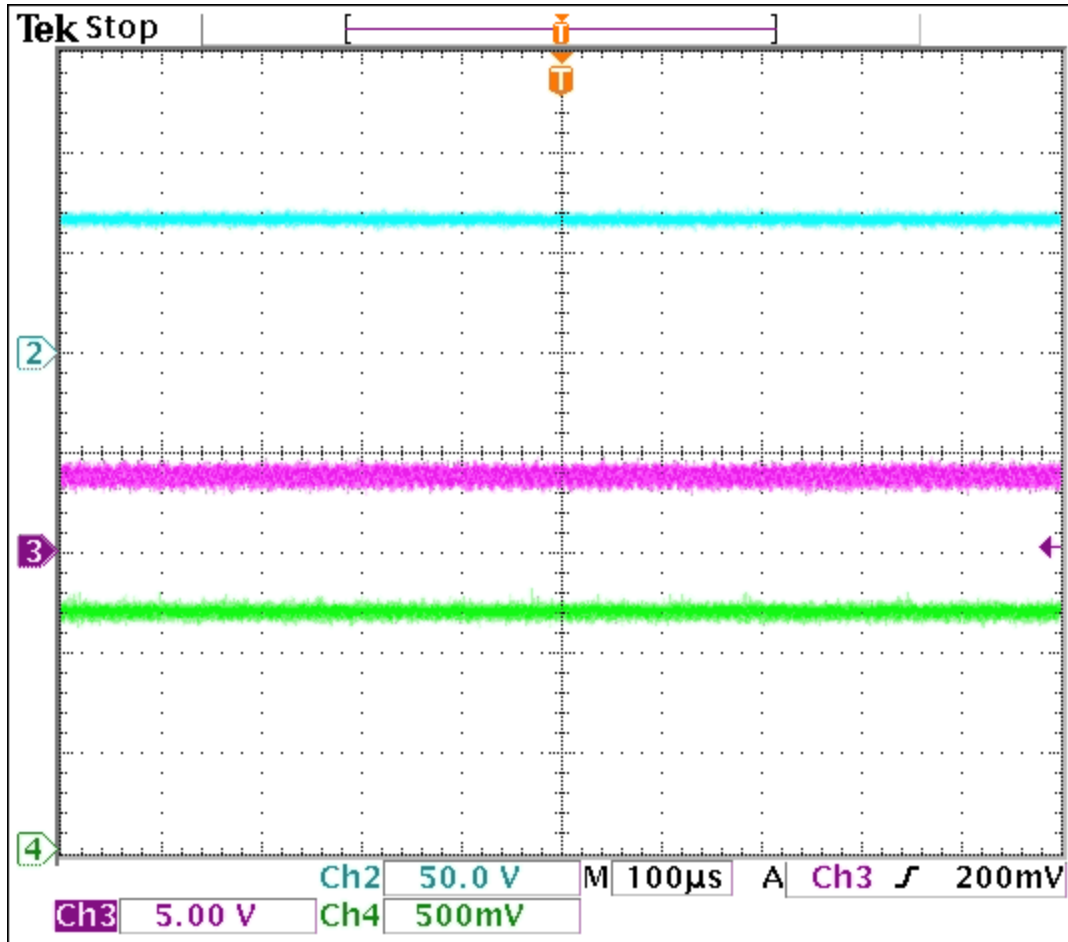


Figure 5. APD (Channel 2), V_{IN} (Channel 3), and APD current-monitoring output across RLIM (Channel 4) at 4mA of APD current.

Efficiency Measurements

Efficiency of the total system is calculated from the test results with 3.3V and 5V inputs, and with the load current varied from 0 to 4mA. **Figure 6** shows the efficiency curve for a 70V output.

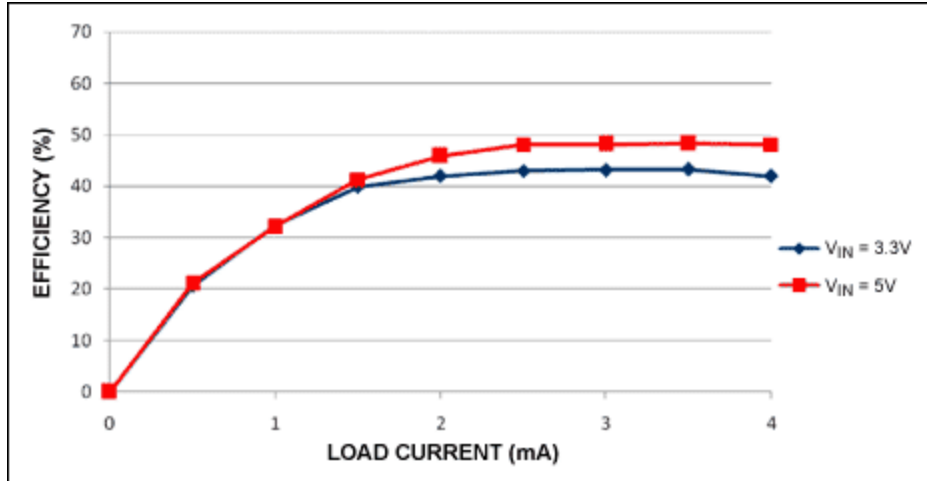


Figure 6. Efficiency versus load current with 3.3V and 5V inputs.

Board Design

Figure 7 shows the layout of this reference design, which fits on a tiny, 12mm x 8mm circuit board. Figure 8 and Figure 9 show the top-layer and bottom layer components, respectively.

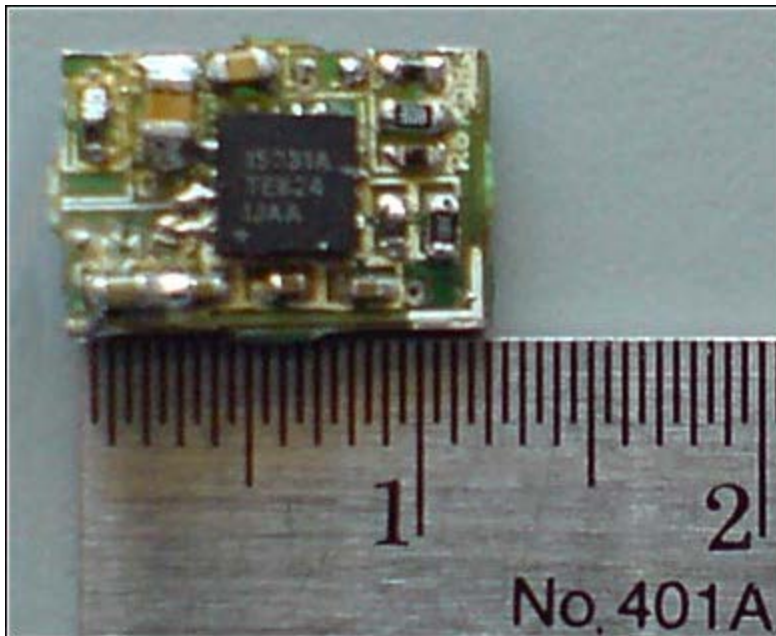


Figure 7. Board layout of the reference design, which measures 12mm x 8mm.

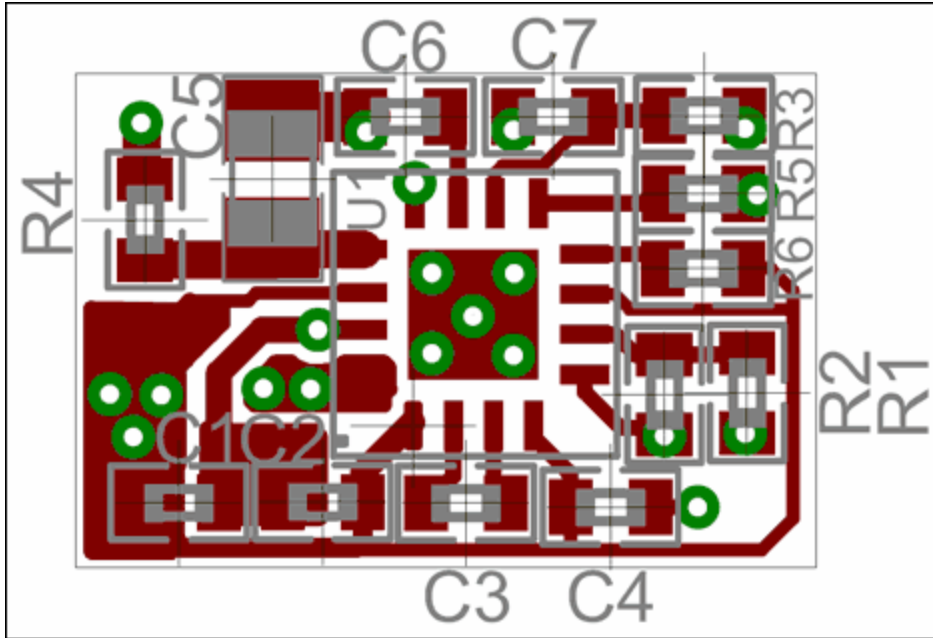


Figure 8. Top-layer components.

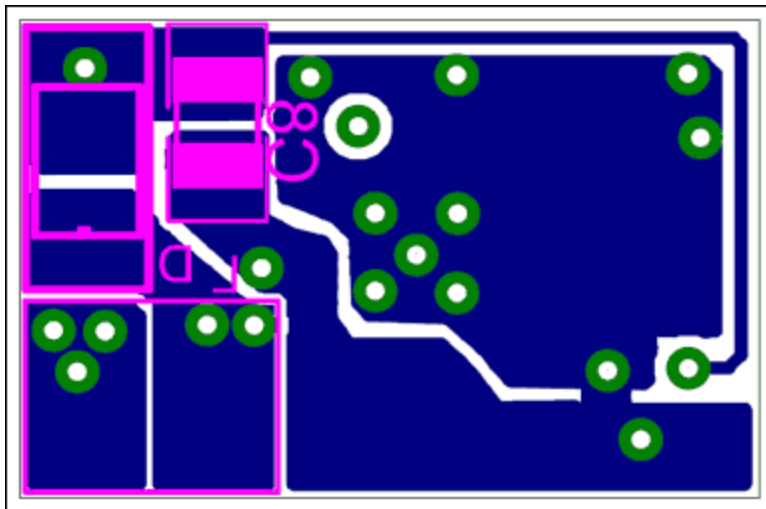


Figure 9. Bottom-layer components.

Related Parts

MAX15031

80V, 300mW Boost Converter and Current Monitor for APD Bias Applications

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REFERENCE DESIGN 4374, AN4374, AN 4374, APP4374, Appnote4374, Appnote 4374

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